University of Colorado Hospital

UNIVERSITY OF COLORADO HEALTH

Extracorporeal Membrane Oxygenation Program

# Interrupting The ECMO Circuit

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# Objectives

- Discuss the need for interrupting the ECMO circuit
- Discuss the infection risks for ECMO patients
- Describe the importance of aseptic technique
- Describe the aseptic procedure interrupting the ECMO circuit

# Reasons to Interrupt the circuit

Device changes

- Oxygenator – occur 13.6% all runs (ELSO)
- Blood pump – occur 7.2% all runs (ELSO)

Replace circuit

- Complete circuit exchange – occurrence unknown

Cannulation changes

- VV > VA, VVA, VAA - occurrence unknown

Emergent repair

- Broken stopcocks, connectors – occur 1.3% all runs (ELSO)

ELSO ECLS Registry Report – International Summary July 2016 78,397 Patients

# Increases Infection Risk

- Health care–associated infections (HAIs) are among the most common complications of hospital care.
- CDC **Healthcare-associated Infections (HAI) Progress Report -** 72000 blood borne infections in 2011
- Blood borne infections are known to cause endocarditis, and other metastatic infections (e.g., lung abscess, brain abscess, osteomyelitis, and endophthalmitis).

CDC MMWR 2011

# ELSO Registry - Infection

ELSO Registry Data reports 15% of patients with blood stream infections and an incidence of 68% mortality in this group.

Increased frequency of infection with

- increasing age
- support > 14 days
- VV DL cannulation

Causitive agents:

- Frequency of circuit interventions
- length of time with vascular access
- Patient deconditioning
- Nutritional status
- Mechanical ventilation
- Airway and airway management

# Bloodstream infection was the most common infection

Duration of ECMO, mechanical complications, autoimmune disease, and venovenous mode seemed to be independently associated with infections.

Sun et al. Perioperative Management

**Infections occurring during extracorporeal membrane oxygenation use in adult patients**

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**Objective:** The application of extracorporeal membrane oxygenation in adults has been increasing, but infections occurring during extracorporeal membrane oxygenation use are rarely described.

**Methods:** We retrospectively analyzed the prospectively collected data on nosocomial infection surveillance of 334 patients aged 16 years or more undergoing their first extracorporeal membrane oxygenation for more than 48 hours at a university hospital from 1996 to 2007 for respiratory (20.4%) and cardiac (79.6%) support.

**Results:** During a total of 2559 extracorporeal membrane oxygenation days, 55 episodes of infections occurred in 45 patients (13.5%), including 38 bloodstream (14.85 per 1000 extracorporeal membrane oxygenation days), 6 surgical site, 4 respiratory tract, 3 urinary tract, and 4 other infections. *Stenotrophomonas maltophilia* (16.7%) and *Candida* species (14.6%) were the predominant blood isolates. In stepwise logistic regression analysis, longer duration of extracorporeal membrane oxygenation use (odds ratio 1.003; 95% confidence interval, 1.001–1.005; $P = .004$), mechanical complications (odds ratio, 4.849; 95% confidence interval, 1.569–14.991; $P = .006$), autoimmune disease (odds ratio, 6.997; 95% confidence interval, 1.541–31.766; $P = .012$), and venovenous mode (odds ratio, 4.473; 95% confidence interval, 1.001–19.977; $P = .050$) were independently associated with a higher risk for infections during extracorporeal membrane oxygenation use. Overall in-hospital mortality was 68.3%, and its independent risk factors included older age (odds ratio, 1.037; 95% confidence interval, 1.021–1.054; $P < .001$), neurologic complications (odds ratio, 51.153; 95% confidence interval, 6.773–386.329; $P < .001$), and vascular complications (odds ratio, 1.922; 95% confidence interval, 1.112–3.320; $P < .001$), but not infections during extracorporeal membrane oxygenation use.

**Conclusions:** Bloodstream infection was the most common infection during extracorporeal membrane oxygenation use. Duration of extracorporeal membrane oxygenation, mechanical complications, autoimmune disease, and venovenous mode seemed to be independently associated with infections. (J Thorac Cardiovasc Surg 2010;140:1125-32)


Supplemental material is available online.

Extracorporeal membrane oxygenation (ECMO) was first reported for adult respiratory distress syndrome in 1972.[1] Subsequently, ECMO was gradually accepted as a treatment modality for neonatal, pediatric, and adult patients with respiratory or cardiac failure who fail to respond to maximal medical therapy. Currently, more than 24,000 neonates, 7000 children, and 2000 adults have been treated with ECMO.[2] Although its use is relatively controversial in adults, ECMO has been gradually used as cardiac support in various clinical settings, such as postcardiotomy cardiogenic shock after cardiac surgery,[3] bridge to heart transplantation,[4] fulminant myocarditis,[5] and assistance for cardiopulmonary resuscitation (CPR).[6]

Infections occurring during ECMO use increase mortality in neonatal or pediatric populations, but whether they have a similar impact on adults has rarely been reported.[7-10] Thus, we assessed the occurrence, type, causative pathogens, and risk factors of infections during ECMO use as respiratory or cardiac support in adults at an extracorporeal life-support referral center. Risk factors associated with in-hospital mortality were also analyzed.


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## MATERIALS AND METHODS

### Setting and Study Population

National Taiwan University Hospital, a university hospital with a 2200-bed capacity, provides both primary and tertiary referral care. It is also an extracorporeal life-support referral center.[5,11] The first ECMO at this hospital was in August of 1994.[5] In the following years, ECMO was performed approximately 30 to 60 times per year before 2003 and approximately 100 or more times per year since 2003. A computerized case



PM

Sun et al., **Infections occurring during extracorporeal membrane oxygenation use in adult patients.** J Thorac Cardiovasc Surg. 2010 Nov;140(5):1125-32.e2

# US Dept Health and Human Services Agency for Healthcare Research and Quality

**Most common ICU room pathogens**

- Gram (+) - Enterococcus, Streptococcus, Staphylococcus, MRSA
- Gram (-) – Acinetobactor, E-coli, Klebsiella
- Fungal – candida albicans
- Spore forming bacteria - C difficile,
  - Bacterial density is highest near the patient
  - Bacteria can last for months on inanmate objects such as bed rails, medical tubings and countertops

# Pathogen Longevity on Inanimate Surfaces

- *Clostridium difficile* (spores) 5 months
- *Escherichia coli* 1.5 hours – 16 months
- Enterococcus spp. including VRE and VSE 5 days – 4 months
- Klebsiella spp. 2 hours to > 30 months
- *Staphylococcus aureus*, including MRSA 7 days – 7 months
- *Streptococcus pyogenes* 3 days – 6.5 months
- *Candida albicans* 4 months

Kramer **How long do nosocomial pathogens persist on inanimate surfaces? A systematic review** *BMC Infectious Diseases* 2006, **6**:130

# ELSO ID TASK FORCE Recommendations

**Chlorhexidine prep should be used, rather than alcohol or betadine unless there is a specific allergy or contraindication.**

**In general, it is recommended that the ECMO circuit be cared for like a protected central line used for hyperalimentation, such that "breaking" the line unnecessarily is strongly discouraged. This will make contamination of the circuit much less likely.**

ELSO Infectious Disease Taskforce Recommendation Summary 2012

# ChloraPrep® Solutions

ChloraPrep® Hi-Lite Orange

Isopropyl alcohol

Chlorhexidine digluconate

FD and C Yellow No. 6


ChloraPrep antimicrobial activity is effective against microorganisms including

- gram-positive and gram-negative bacteria,
- Methicillin-resistant *Staphylococcus aureus* (MRSA),
- Vancomycin- resistant *Enterococci*(VRE),
- *Clostridium difficile, Acinetobacter*, and most viruses and fungi.

**ChloraPrep® Solutions** Safety Data Sheet 30/03/2015

# Betadine Aqueous

## Drug Facts

**Active ingredient** — **Purpose**

Povidone-iodine, 10% (1% available iodine)..... Antiseptic

### Uses

**Patient pre-operative skin preparation**

- for preparation of the skin prior to surgery
- helps reduce bacteria that potentially can cause skin infection

### Warnings

**For external use only**

**Do not use**
- in the eyes
- if you are allergic to povidone-iodine or any other ingredients in this preparation

**When using this product**
- prolonged exposure to wet solution may cause irritation or, rarely, severe skin reactions
- in pre-operative prepping, avoid "pooling" beneath the patient

**Stop use and ask a doctor if**
- irritation, sensitization, or allergic reaction occurs and lasts for 72 hours. These may be signs of a serious condition.

**Keep out of reach of children.** If swallowed, get medical help or contact a Poison Control Center right away.

### Directions

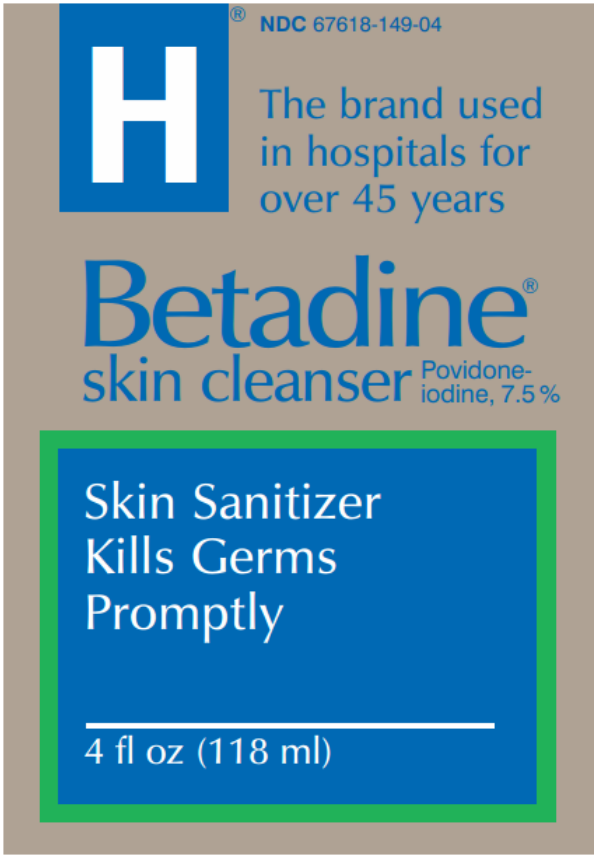
- clean the operative site prior to surgery
- apply product and allow to dry
- may be covered with a bandage

### Other information

- store at 25°C (77°F); excursions permitted between 15°-30°C (59°-86°F)
- store in original container

**Inactive ingredients** pareth 25-9, purified water, sodium hydroxide

**Questions?** 1-888-726-7535 (8am-5pm, EST, Mon.-Fri.).



# Set Up and Good Practice

## Set up

Sterile instrument tray with heavy scissors and (8) tubing clamps

(2) packs of blue towels (4) - 3/8”x3/8” Tubing connectors

Halyard Medium Drape #89111 76”x44”

32 oz bowl Medical Action Industries #01232

(2) 30cc saline-filled syringes or Bulb Irrigation Syringe

(2) surgical gowns, masks, caps, sterile gloves

(2) 4x4 Covidien Curly gauze sponge trays

(2) 4oz MediChoice 10% providone iodine aqueous solution

(2) 26 ml Chloraprep prep sticks

(2) bath towels or bed blankets if working over floor

## Practice

- Place emergency resuscitation cart and ECMO cart at the room.
- Set up sterile field and work space
- Identify locations where tubings will be cut.
- One person suspends and holds tubings while one person preps tubings
- One person cuts and makes connections while one person provides saline for wet to wet connection
- Both assess for air free connection prior to reinitiating flow

# Procedure

•Prep areas to be cut with Providone-iodine or Chloraprep and allow to dry.

•Prep from “clean to soiled” areas taking care not to transfer microorganisms from the periphery back to the proposed incision site.

•When using betadine aqueous, “Double dipping” into the antiseptic solution with a contaminated sponge may lead to microorganisms being brought back to the proposed incision site.

•Do not “back track” over an area that has already been prepped with the same prep sponge.

1. Prep areas to be cut
2. Perform a “Time Out” to verify the procedure and patient with the physician.
3. Establish full ventilation, inotropic and vasopressor support according to etiology of disease and patient requirements.
4. When ready and personnel positioned, reduce RPM to 1500 on physician order.
5. Clamp access and outflow tubings near pump system and away from where tubings will be cut.
6. Double clamp the tubings where the new attachments will be made and divide between the clamps with the sterile heavy scissors
7. Connect the new circuit or component with a wet-to-wet, bubble-free connection using 3/8”x3/8” tubing connectors and the large saline-filled syringes. Make sure that the tubing is pushed over the 2nd barb on the end of the connector.
8. Resume extracorporeal support upon physician’s order with RPM starting at 1500.
9. Unclamp access and return lines and advance flows to previous settings while assessing circuit/component flow for air and patient for hemodynamic response.

# Affect of Aseptics on Plastics

Toluene, Benzene, Acetone and Ammonia will affect polycarbonate.

Alcohol should not be used on polycarbonate connectors, but can be used on polyvinylchloride tubings

References Maquet Cardiovasular – Quadroxi-adult IFU

Do not allow solvents such as alcohol, ether, acetone, or liquid inhalation anesthetics (e.g. isoflurane, Ethrane (enflurane)) to come into contact with the outside or inside of the oxygenator, as they may cause damage.

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*Instructions for Use | US/CA Version | G-152 | 2011-03*